One Policy for All?

Teachers' Varied Labour Market Trajectories and Regulatory Implications

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While in most countries regulation of teachers' qualifications, working time and compensation is uniform across teaching specializations (subjects), the actual teaching experiences, as well as potential opportunities outside the education sector can vary widely based on the subjects taught. Combining administrative data on public school teachers from Poland, and data on professional careers of university graduates not employed in schooling, we identify key differences between 14 major school subjects. We then discuss how these differences may affect the recruitment and attrition of teachers in schooling system, as well as the self-selection to the teaching profession. Additionally, we offer recommendations to enhance the flexibility of existing regulations governing the teaching profession. Lastly, we assess the broader applicability and relevance of our findings beyond the confines of the Polish educational landscape.

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Abstract

While in most countries regulation of teachers' qualifications, working time and compensation is uniform across teaching specializations (subjects), the actual teaching experiences, as well as potential opportunities outside the education sector can vary widely based on the subjects taught. Combining administrative data on public school teachers from Poland, and data on professional careers of university graduates not employed in schooling, we identify key differences between 14 major school subjects. We then discuss how these differences may affect the recruitment and attrition of teachers in schooling system, as well as the self-selection to the teaching profession. Additionally, we offer recommendations to enhance the flexibility of existing regulations governing the teaching profession. Lastly, we assess the broader applicability and relevance of our findings beyond the confines of the Polish educational landscape.

1. Introduction

The aim of this paper is to present robust evidence that will contribute to the ongoing international discourse on the widely debated policy area of regulating school teachers' work. While job requirements and working conditions for teachers are standardized in many countries, the regulations are typically uniform across different teaching specializations. However, in some education systems, such as in Poland, teachers are required to hold a university degree closely related to the subject they teach. As a result, teachers of different subjects face varying opportunities in the labor market outside of education. They also experience distinct professional career trajectories and different logistics in their work as educators. This inconsistency may cause difficulties in recruiting teachers for certain subjects and accelerate the attrition of those already in service, thereby contributing to selective shortages.

The article is the first one using unique, administrative data that enable individually following all teachers from Polish public schools and preschools across different places of employment and horizontally over time, with details inaccessible otherwise such as specialization, wages, mobility, dropout, etc. This is coupled with individual student data compiling administrative systems for higher education and social security that allow for employment and opportunity wage analysis. Through triangulating these sources, the paper answers the question on whether all teachers are created equal and what the policy implications of such an answer are.

In Section 2, we review regulations on teachers' work across various countries, including those pertaining to wages, working hours, and formal requirements for entering the profession. We also address the issue of teacher shortages, with a particular focus on differences between school subjects. Additionally, we introduce the Polish context to help readers better understand the external validity of the analysis based on data from Poland, as well as the limitations of such an analysis.

In Section 3, we explain the methodological approach, detailing the rationale behind the 18 indicators used in the study and describing the data sources.

Sections 4 and 5 present the results of the analysis and the discussion, respectively. The values of the indicators are divided among 14 major school subjects taught in Polish schools. The discussion offers an interpretation of the observed differences within the context of existing regulations. Based on this, we formulate policy recommendations.

2. State of the art.

2.1. Regulations on teachers' work across countries

Statutory salaries

According to regulations and salary data collected by OECD (2022), in most countries teachers' statutory salaries are not uniform. They generally increase with the level of teacher's

formal qualifications, experience in schooling, and - less commonly - with the tier of school in which the teacher is employed.

The progression of salaries due to years of service is very common among countries, as it helps to retain experienced teachers in the education sector. Moreover, length of service is one of the easiest inputs to measure. European educational systems (European Commission/EACEA/Eurydice, 2022) can be divided into 4 groups: those with significant increase in the first 15 years, significant increase over a long period, modest increase over a short period, and modest increase over a long period.

Regulators in some countries acknowledge that teaching in higher grades requires higher competences from teachers. In Belgium, Denmark, and Lithuania, upper secondary teachers with 15 years of experience earn between 25% and 30% more than pre-primary teachers with the same experience, while in Finland they earn around 50% more. This progression is much smaller in Chile, Costa Rica, Slovenia, Turkey and the United States (less than 5%), and it does not exist in Colombia, England and Scotland, Greece, Poland, and Portugal (OECD 2022).

Assigning teachers with additional tasks is another lever allowing for differentiated salaries. Teachers may perform different roles in schools independent of their teaching duties. In most national systems, such activities as individual mentoring, training young teachers, coordinating projects, supervising the class, as well as the managerial roles are typically connected with additional monetary compensation.

Teacher appraisal mechanisms may also be used to differentiate the earnings. In addition to providing teachers with feedback on their work, they may lead to awarding better teachers with financial bonuses, or with earlier promotion to higher professional degree, and in result to higher pay (European Commission/EACEA/Eurydice, 2021). Regulations concerning teacher evaluation are country-specific. For example, the eastern Member States, 3 Baltic countries and Sweden have the majority of their teachers appraised at least every year, in other countries this process happens less often. Typically, school headmasters play an important role in the evaluation of teachers.

In some more decentralized countries, statutory salaries will differ across regions as well. As reported by the National Educational Association (NEA 2022), in the U.S. the average yearly earnings of a starting teacher in 2021–2022 varied from $56,313 in the District of Columbia (DC) to $33, 495 in Montana, In other words, the least-paying state was offering starting teachers only 57.8% of what they could potentially earn if they worked in DC. Large disparities can occur even among districts within the same state (Podolsky et al. 2016). Importantly however, although teacher shortages are selective in nature, decisions at the state or district level to raise teacher salaries tend to be across-the-board policies, failing to take into account that the balance between teacher supply and demand varies considerably by location and teaching specialization (Wyckoff 2024).

With educational systems facing teacher shortages in particular subjects, some authors suggest wage differentiation could act as a remedy (Murphy, DeArmond, Guin 2003). The argument is that shortages are most evident in fields where prospective teachers face attractive labor market alternatives to teaching, and high opportunity wages (Podolsky et al. 2016, Herbst and Orchowska 2023). However, differentiating basic salaries between teachers of different subjects is an uncommon practice among European countries. More often (as in the cases of

Bulgaria, England, Wales, and Serbia), teachers of priority subjects or starting teachers are tempted with rental and transport allowances, training bursaries and scholarships (Eurydice 2019).

Working time

Most countries do regulate their teachers' working time. However, according to OECD analyses, they differ in how they address this issue (OECD, 2022). Regulations may refer to all activities within the work contract, teaching hours, and/or teachers' availability at school. In general, full-time teachers, just like representatives of other professions, are required to work 40 hours per week, with some countries' hours regulated by the civil servants law, not profession-specific (for example Costa Rica, Switzerland and Türkiye). Statutory working time definitions differ as well, with law outlining either a minimum (Denmark, England, Korea) or a maximum number of working hours (Norway, Poland, Scotland). Different systems experience large variation in the length of their school year (151 days per year in the Flemish Community of Belgium to 50% more in Germany and Norway: 225 days) and in the number of hours (505 hours per year in Mexico to 250% more in Germany: 1 755 hours annually). The teaching load is much more differentiated, with the number of teaching hours decreasing with higher education levels. Upper-secondary teachers in Japan, Norway and Turkey are expected to spend 33% of their time in class, while in Latvia and Scotland the weekly teaching time reaches 63%. The most comprehensive global daily average teaching time is four hours as reported by Education at a Glance report, however it "ranges from fewer than 500 hours per year in Poland to more than 1 000 hours in Costa Rica" leading to "three hours or less per day in the Czech Republic, Finland, Japan, Korea, Norway, Poland, the Slovak Republic, Slovenia and Türkiye", and "six hours or more in Costa Rica". Absences, shortages or "nature of the data" can be used to explain differences between statutory and actual teaching time for a few countries for which both are reported (Polish teachers report working up to 25% more hours than statutory requirements). No subject specific regulations were reported in the analyzed systems.

Formal requirements to enter the profession

In most countries obtaining teaching qualifications is based on Initial Teaching Education [ITE] programmes that can be divided into consecutive and concurrent ones. In the first ones prospective teachers focus on ITE with general academic subjects provided alongside professional subjects, while in the latter ones future teachers first develop their knowledge in a specific area of knowledge that is eventually supplemented by didactic training (European Commission/EACEA/Eurydice 2021). Looking beyond the EU, the concurrent model is present "in more than three-quarters of OECD and partner countries" up until upper secondary school level where the consecutive model "is approximately as common as the concurrent" (OECD, 2022).

With the teacher shortages escalating, European Union documents have called the existing system "lengthy and rigid" (see European Commission/EACEA/Eurydice, 2018). To broaden the entry gate to teaching countries have been developing alternative pathways, now existing in about one third of the European education systems. Two main organizational models can be distinguished in this matter. Short professional-oriented programmes delivered by established ITE institutions in a flexible manner (part-time, distance, blended learning as well as evening courses) are available in Belgium, Denmark, Germany, Slovakia, Sweden, and also outside of

the EU, in North Macedonia, Switzerland and Turkey. The second approach is employment-based. Candidates work in a school and follow an individual training programme leading to the teaching qualification. Such programmes are common in Latvia, Lithuania, the Netherlands and parts of the United Kingdom (European Commission/EACEA/Eurydice, 2021). Similarly, some of the "troops-to-teachers" career-change programs have been tested out and implemented by Non-Governmental Organizations such as Teach For All initiatives with the aim to "lure the "best and brightest" into understaffed schools" (Crawford-Garrett, K & Thomas, 2018).

2.2 Supply of teachers

Policy reports in the EU have been raising the issue of teacher shortages for over a decade now (European Commission/EACEA/Eurydice, 2013), yet in some parts of the world this problem exists much longer (Cf. Darling-Hammond and Podolsky, 2019). Shortages are also observed in the U.S. schooling system.

The negative impact on educational quality becomes apparent. In California districts were reported hiring long-term substitutes or teachers with substandard credentials, leaving positions open, growing class sizes, or canceling the course altogether (Darling-Hammond et al., 2018). Given that the different aspects of working conditions are interrelated and the lowering quality risk associated with more flexibility in multiple pathways available, a need for consistent and comprehensive policy measures arises.

The shrinking pool of candidates and drop-outs from the teacher profession are considered as a threat for the quality of education (Eurydice 2019). However, it should be noted that shortages are not the only representation of misalignment between teachers' supply and demand. Shortages and oversupply of teachers coexist in eight European countries (Spain, Italy, Greece, Lithuania, Portugal, Liechtenstein, Montenegro and Serbia). For example, Greece experiences "general oversupply of available teachers (...) with shortages in some geographical areas, i.e. remote regions and low-inhabited islands" while Portugal has "a lack of teachers in specific subjects and regions on the one hand, and a general oversupply of teachers in other subjects and regions" (European Commission/EACEA/Eurydice 2021).

Geographical differences matter, with remoteness, economic opportunities, cultural context and difficulty of the school environment coming to the forefront. Sometimes, the whole regions are negatively affected: "in Germany, in the Eastern Länder, there is a shortage of around 1 600 teachers per year, corresponding to a deficit of 27 %" (Eurydice 2019). Urban vs rural divide also plays some role, with urban schools tending to have higher turnover of teachers than do suburban and rural institutions. Difficulties to attract teachers to some metropolitan areas may be related to high cost of living and, in some cities, a larger share of pupils from disadvantaged families (Ingersoll, 2003 and Eurydice 2019). However, researchers generally agree that, regardless of the location, students in high-poverty and high- minority schools typically feel the largest impact of teacher shortages (Sutcher et al., 2019). US-based authors point out that variation between schools, even within the same administrative units, is more important than the aggregate geographic perspective, (Cf. Darling-Hammond, 1997; Ingersoll, 2003; Sutcher et al., 2019).

School ownership, i.e. whether it is private or public contributes to the complexity of the picture. In the early 2000s the US private schools tended to experience higher teacher turnover

rates than did public schools, but there were also large differences among institutions (Ingersoll, 2003). However, more recently and internationally, TALIS data showed higher job satisfaction in private vs public schools with hypotheses worth further exploration: higher pay, access to resources, more engaging work environments or greater professional autonomy (Schleicher, 2020).

Shortages are clearly uneven for teachers in different subjects. Typically, tertiary school graduates in STEM fields (science, technology, engineering and mathematics) face high opportunity wages on the labor market, and for this reason in many countries it is particularly difficult to find teachers of mathematics, physics, and informatics (NIK, 2021). Other "problematic" subjects are those with more demanding working conditions such as special-needs or bilingual education. For high-need populations, "shortages extend to other subject areas, including English and elementary education." (Darling-Hammond et al., 2018).

Ingersoll (2003) has long argued the underlying reason behind labor shortages is connected to high attrition rather than insufficient recruitment. The problem seems particularly pertinent among the novice teacher, with US data estimating 40-50% of the incomers to the professions leaving within the first 5 years of such "trial by fire" (Ingersoll and Strong, 2011). More globally, TALIS results show that younger teachers are more likely to question their choice of a career path, feel less satisfied "with their job and work environment" and "more likely to express a wish to change to another school" (Schleicher 2020).

2.3. The Polish context

In Poland, most arrangements concerning the professional status of a teacher are contained in the Act of 26 January 1982. - Teachers' Charter (Teacher's Charter 1982). Some regulations are also embedded in the more general act on Education Law (Education Law 2017.).

Teachers' Charter sets out the rules for hiring and firing teachers, pension entitlements, the rights and duties of teachers, the way in which teachers' work is supervised and the rules of disciplinary responsibility. The Act applies, in particular, to teachers, educators and other teaching staff employed in public preschools, primary schools, and secondary schools, teacher training centres, reformatories, juvenile detention centres and family diagnostic and counselling centres. However, selected paragraphs, including those referring to qualification requirements, rules of professional promotion, and disciplinary responsibility also apply to teachers in non-public educational institutions.

The review of legal acts concerning the teaching profession allows us to recognise that the regulatory framework varies in detail depending on, inter alia, the place and specifics of the teacher's work, the degree of professional promotion, seniority. At the same time, the Teachers' Charter does not make any distinction between teachers in different subjects.

Salaries

Responsibility of determining teachers' salaries in Poland is split between three actors: the parliament, which defines the elements and method of calculating a teacher's in the Teachers' Charter, the Minister of Education, who issues an ordinance including minimum basic salaries

of teachers at different professional degrees[1], and finally the local government, which acts as the employer of teachers in public schools, makes decisions on actual wages of individual teachers.

According to Teacher's Charter (art. 30), a total salary of a teacher consists of:

- basic salary,
- allowances,
- remuneration for overtime and extra hours,
- awards and selected other benefits resulting from the employment contract

The minimum basic salary of a teacher is set by the Minister of Education, separately for each of the 4 professional degrees (which we describe in more detail later on in this section). Local governments are allowed to increase these salaries above the required minimum, but they rarely do so, as some allowances imposed by the regulations are scaled based on the amount of basic salary, and hence the consequences of such a raise are hardly controllable by the employer (Herbst et al. 2009).

Teachers are granted seniority, working conditions, overtime, functional, and motivational allowances. While the calculation of the former three is precisely defined in the regulations, the latter two are determined by the employer - typically by the local government. Motivational allowance is the most common instrument used by local authorities to increase the teacher's wage.

The minimum basic salary of a teacher is not the only wage standard set at the country level. The Teacher's Charter also regulates the average total teacher salary (including all the allowances) to be met at the territory of each local government running schools (art. 30). Controlling the average wage in the territorial unit (rather than individual salaries) is a compromise between leaving local governments some autonomy with respect to rewarding teachers' work, and preventing the excess wage inequalities among teachers - both within and between the territorial units.

Working time

In Poland, the weekly working time of full-time teachers is 40 hours per week. Within this time (and the fixed remuneration) the teacher is obliged to carry out all the professional activities: teaching, preparation for classes, professional, as well as other tasks granted by the school.

The Teachers' Charter separately regulates the teaching time, that is, time devoted directly to teaching in class (so called pensum). In the case of most school teachers, including teachers in all subjects discussed in this study, the weekly pensum is 18 hours. Discounts are set for teachers in management positions. For preschool teachers, the pensum varies from 22 to 25 hours per week, depending on the age of the children in their care.

Formal requirements for entry into the profession

To become a teacher, one needs to obtain a higher education degree with adequate pedagogical preparation. Subject teachers are obliged to hold at least a master's degree and vocational

[1] In the period covered by our analysis there were 4 professional degrees in the teaching profession: a novice teacher (intern), contracted teacher, nominated teacher, and licensed teacher

trainers should have either a master's or bachelor's degree, while the pedagogical preparation is required for both groups (Bielecki, Maliszewska and Matuszczak, 2022).

In addition to appropriate education, to enter the profession one also has to observe basic moral principles and meet the necessary health conditions (Teacher's Charter, art. 9).

Detailed qualifications required of teachers are specified, by way of an ordinance, by the Minister of Education (or - in the case of specific types of schools - by other ministers). The current regulation on the standard of education preparing for the teaching profession defines the standards of qualifications for three categories of educators:

1) teachers (subject, theoretical vocational subjects, practical vocational training, classroom teachers and psychologists)

2) pre-school and early childhood education teachers (grades I-III of primary school)

3) special educators, speech therapists and teachers conducting classes in early childhood development support.

Teachers in the first group are required to have completed a first-cycle, second-cycle or single master's degree in a field, level and profile matching the learning outcomes specified in the curriculum of the subject taught. Alternatively, the necessary credentials may be obtained by completing adequate postgraduate studies.

Pre-primary and early childhood teachers are required to have a master's degree in pre-primary pedagogy or early childhood pedagogy. Teachers in the third indicated group are required to have a uniform master's degree in special pedagogy or first- or second-cycle studies in a subject other than special pedagogy.

3. Methods and data

This work compiles different administrative datasets on Polish teachers to illustrate the working conditions and labor market opportunities faced by teachers of different subjects. An important context of this undertaking is provided by the existing regulations on teacher work, which fail to take into account the specificity of teacher specializations.

Our methodology involves analyzing the educational sector as a workplace, considering the different stages of employment for teachers. This approach falls under the broader category of Teacher Workforce Dynamics Analysis. An early example of this type of analysis is the multivariate models developed by the U.S. Department of Education, which identify factors influencing teacher retention and attrition based on data from the Schools and Staffing Survey (SASS) and the Teacher Follow-Up Survey (TFS) (Arnold et al., 1993). These survey tools were later replaced by the National Teacher and Principal Survey (NTPS).

Another methodology similar to ours is employed by the Economic Policy Institute (EPI) and the Center on Wage and Employment Dynamics (CWED) to estimate the teacher pay penalty in the U.S. (Allegretto & Mishel, 2019).

In our work we focus on 14 subjects with the highest number of teaching hours in the course of primary and secondary education in Poland, that is (in alphabetical order): biology,

chemistry, English, German, physics, geography, history, informatics, mathematics, early education, religion (catholic), and physical education.

In order to characterize the educational sector as a workplace, we develop a set of statistics, which we divide into three groups reflecting different aspects and stages of employment. First, we focus on the ability of schools to attract young teachers of different subjects. In the next step we characterize the average workload of teachers, and the logistical challenges related to combining work in different institutions. Finally, we turn to the perspective of an established teacher, as we analyze the relative attractiveness of the teaching profession after 4-7 years of work. All the indicators used in this stage of the analysis are listed in table 1.

TABLE 1: HERE

When analyzing the structure and working conditions of teachers we rely on the System of Information on Education (SIO) - a database used by the Polish Ministry of Education to monitor the education sector and to assign funding for the local educational authorities (local governments and other institutions running schools). SIO includes data on all teachers in public schools and preschools (more than 500,000 records), allowing us to analyze their specialization, employment history, wages, mobility, dropout, etc. Because of the organizational changes in SIO introduced in 2019 which made it impossible to continuously track teachers' careers between the old and new version of the system, we focus on the period 2013-2018, occasionally reaching back to data from 2011. For some indicators we also chose not to cite the most recent data, as we preferred to select a group of teachers in the earlier period, and then track their careers in the following years.

To approximate the expected teacher wage at different stages of the career we use the average wage for particular degrees of teacher's professional advancement, as published by the Ministry of Education. Although the averages may not perfectly reflect the remuneration of individual members of the teaching staff, the actual variability of wages among Polish teachers with similar formal credentials and professional experience is limited due to regulations imposed by the Teacher's Charter act (Herbst et al., 2009, Herbst and Wojciuk, 2014).

While investigating employment decisions and opportunity wages faced by graduates of different university fields, we use data from the ELA system - an evaluative tool developed by the Ministry of Education and Science to monitor the professional careers of graduates from tertiary schools. It combines information on individual students, as extracted from the administrative systems of higher education institutions, and data on their employment from the social security system.

Both sources of information listed above - SIO and ELA - are administrative systems including data on the whole populations of, respectively, teachers and university graduates. However, in the case of one measure used in our research, namely the percent of teachers holding a degree matching the subject they teach, there is no necessary information in these systems. We therefore relied on the survey of teachers from Warsaw schools which we have administered online in April of 2022 (N=1433). Due to the specificity of the labor market of the largest Polish agglomeration, the sample of Warsaw teachers is definitely not representative for the teacher population in the whole country. For this reason the values of the aforementioned

indicators are useful for the comparisons between teachers of different subjects, but not to measure the exact degree to which teachers' education match their professional specialization.

4. Results

According to many voices in the public debate on education - in Poland and other countries, the low starting salaries offered to teachers are one of the reasons for staff shortages and negative self-selection into the teaching profession (Han, 2020). Our data show that it is likely to be true for some of the teacher specializations, but not for the whole profession (see column 1 in table 2).

When comparing the actual starting wages for graduates from different university fields with the wage offered to young teachers, we can see that those holding a degree in either informatics, foreign languages, physics or mathematics typically get higher initial pay outside the education sector than they would earn as teachers. However, for graduates of such fields as biology, chemistry, Polish philology, geography, history and physical education, the teacher's starting wage is rather attractive compared to the opportunities outside the schooling sector.

Interestingly, there is no obvious correlation between the opportunity wages of prospective teachers right after graduation, and the percent of gradu ates from a given field who actually start to work as teachers. Clearly, there are fields, mostly ones related to natural sciences (biology, chemistry, geography) which do not yield graduates attractive wages immediately after entering the labor market, yet school work remains an unpopular choice among their alumni. Unsurprisingly, highest interest in teaching is observed for graduates of pedagogical programmes and - less expectedly, theological studies (column 2 in table 2)[2].

Teacher specializations differ in terms of average age and experience of the teaching staff. On average, novice teachers account for 2.7% of the teaching staff in Poland, whereas the inflow of 'fresh blood' is most noticeable among the English language teachers (4.4%), and it is negligible among physicists (0.8%). English teachers are also youngest: Their average age is 39.4, considerably less than it is for such teaching specializations as early education (47.4), physics, and biology (46.8).

TABLE 2: HERE

Overall, when considering all subjects together, the opportunity wage within one year from graduation is 98.0% of the starting wage for teachers. The percentage of peer graduates working as teachers is 18.4%, and the percentage of novice teachers in the workforce is 2.7%. The average age of teachers is 44.8 years.

According to the Teacher's Charter Act, all teachers working in Polish schools are required to hold a university degree in the field that corresponds to the subject taught, and (if it is not part of their study programme) to complete the supplementary programme preparing them to teach. Unfortunately, SIO data only allows us to check the level of education achieved by teachers, but not whether their fields of education actually match the subjects they teach. To gather this

[2] This phenomenon is related to the fact that classes of catholic religion (dominant in Poland) are provided by the vast majority of schools.

information we ran a supplementary survey among teachers in Warsaw schools (see section 3 for details). Although we need to keep in mind that the sample of Warsaw-based teachers may not be representative of the whole teachers' population, the results of the survey (presented in column 5 of table 2) are still intriguing. As it turns out, only 75% of teachers hold a university degree matching the main subject they teach, and there are substantial differences between subjects. As it turns out, the proportion of matching-degree holders is very low among teachers in informatics (34.5%), and relatively low for STEM teachers (68% for mathematics, 60% for physics, etc.). Highest proportions are observed among teachers of Polish, Physical education, and less common foreign languages such as German and French.

Table 3 offers an insight into the organization of teachers' work by subject, at different stages of teachers' careers. The first 3 columns indicate the average number of schools where teachers of a particular subject work in the 1st, 3rd and 6th year of their employment. For example, biology teachers work in an average of 1.31 schools in the 1st year, 1.35 schools in the 3rd year, and 1.65 schools in the 6th year. The common trend for most subjects is that multi-employment becomes more popular along with teachers' experience. Importantly, this may be caused both by demand and supply related factors. More experienced teachers may need to work more in order to make up for their otherwise insufficient pay. Experience helps also to combine work in two different schools without scarifying the quality of teaching. Finally, if shortages of teacher grow over time, teachers may decide work more to fill the vacancies.

Last 3 columns show in turn the average workload of teachers (within school and subject) as a percentage of full time. For biology, it is 44% in the 1st year, 48% in the 3rd year, and 45% in the 6th year.

As it turns out, the logistics of teacher work is very different among subjects. Early education teachers work in just one school, typically full-time, with one group of students. Also English teachers have a relatively high workload within one school, with the average ranging from 81% to 92% of full time across the years. In return they tend to have one workplace. At the other extreme, informatics teachers have the average workload within one school ranging from 30% to 41% of full time. Experienced STEM teachers, except for mathematicians, are typically employed in more than one school.

The organization of work clearly depends on how much time is assigned for a given subject in the school curriculum (see column 7 in table 3 for the average weekly teaching hours in grades 4-8). Subjects with larger share in the total teaching time require less traveling between schools from the teacher, as more classes need to be given to the same group of students. In turn, those teaching "less prominent" subject typically need to combine posts in different schools to fulfill the work contract.

As for general trends, in the case of many subjects the number of workplaces per teacher increases along with the experience of teachers. This applies to biology, chemistry, physics, history, geography, and less common foreign languages: French and German. As a consequence, the organization of the work for teachers in these subjects diverges from the experience of those implementing the "core" curriculum in each school: teachers of Polish, English, early education and mathematics. In the 6th year of their work, chemistry teachers are employed in more than 2 schools on average, while their colleagues who teach mathematics or early childhood education still work in one place.

TABLE 3: HERE

Let us now discuss the attractiveness of working in a school from the perspective of an established teacher. We consider the working conditions of teachers in the 4th year of their career, and we compare them to those of non-teaching graduates from the respective university programmes at the same stage of their careers (see table 4).

We start by considering the opportunity wage of teachers in different subjects as measured in the fourth year from graduation. Subjects like informatics (280.9%), physics (175.4%), and mathematics (171.7%) show high opportunity wages, indicating that teachers in these subjects have much higher earning potential outside the education sector (should they have chosen not to work in education after graduation). Other subjects like Polish (109.5%) and Early education (101.4%) have opportunity wages that are close to what is earned by teachers. However, differently from the situation immediately after graduation (as shown earlier in table 2), there is no school subject for which the wages offered to teachers are attractive compared to what graduates of corresponding university programmes can earn outside schooling. The comparison of opportunity wages for the teachers in different subjects one year and four years after graduation is shown in figure 1.

FIGURE 1: HERE

When it comes to the percent of peer graduates working as teachers in the fourth year from graduation, it ranges from fields like theology (44.7%), physical education (29.0%), and early education (32.8%), where a significant proportion of graduates continue to work as teachers, to informatics (0.4%) and physics (2.0%), where pursuing teaching careers is very uncommon.

According to our data, about 22% of Polish teachers drop out of the public school system within 4 years after they start their careers. This metric ranges from 16% for mathematicians to 33% for French teachers. Interestingly though, the difference between subjects seem not to be directly correlated with the opportunity wages for graduates of corresponding fields. One reason behind this rather unexpected phenomenon may be related to informal mechanisms of retaining teachers in particular subjects. For example, the shortage of teachers of some specializations may result in their faster promotion to higher professional degrees, even though formally, the rules of promotion are identical for teachers in all subjects (Teacher's Charter 1982). Columns 1 and 4 in table 4 show that teachers in informatics, who face highest opportunity wages on the labour market, also show the highest percent of those promoted to "nominated teacher" degree within 7 years of experience (66% compared to the average of 53% for all school subjects). Clearly however, such a "compensation" mechanism is not the only determinant causing divergent promotion schemes in different subjects. Physical education and history are other examples of subjects with fast promotion of teachers, despite their relatively low opportunity wages. The lowest promotion rate is observed for chemistry teachers (43%)

TABLE 4: HERE

Table 5 allows us to look at a young teacher's career from the point of view of the stability of their specialization. According to Polish regulations, in order to teach any subject, a teacher needs to graduate from the corresponding programme (e.g. geography, mathematics) at the university level, and then (or simultaneously) receive the so-called pedagogical training. However, as we already observed in table 3, it is possible for teachers already in service to acquire the entitlement to teach based on post-degree courses, which facilitates the change of subject taught.

Columns 1 and 2 in table 5 show the percent of teachers who started their school career in 2013, and eventually either stuck to their initially chosen subject (column 1), or switched to another subject (column 2) according to 2018 data, that is five years later. Clearly, the stability of teaching specialization depends on whether the subject belongs to the core of the school curriculum or it rather plays a supplementary role in the curriculum. Considering English, Polish, mathematics and Physical education, subjects that jointly account for at least 16 hours weekly according to the curriculum, more than 90% of teachers in these subjects did not switch their subject of instruction within the analyzed 5-year period. At the other extreme, 30% of chemistry and physics teachers, as well as about one-fourth of biologists, informatics teachers and French teachers switched to another subject between 2013 and 2018.

TABLE 5: HERE

In order to better understand the mobility of teachers between subjects taught, we will now use a transition matrix (see figure 2). The rows of the matrix represent the main subject of novice teachers in 2013, and the columns represent the main subject of those same teachers in 2018. Each cell in the matrix contains the corresponding percentage or proportion of teachers transitioning from the subject of the row to the subject of the column.

In line with data discussed earlier, the majority of teachers in each subject as for 2013 stuck to this subject in 2018. However, the patterns of transition for the remaining "mobile" teachers are quite diversified among subjects.

FIGURE 2: HERE

Although biology, chemistry, and physics are separate subjects throughout Polish schooling (with the exception of grade 5, when they are combined into 'nature'), teachers switch between subjects relatively frequently within this science-related area. As much as 17% of educators whose primary subject was biology in 2013, teach chemistry as their main subject in 2018. Transition in the opposite direction is almost as common (12%). Almost 9% of former chemistry teachers now teach mainly physics.

English is almost universally picked by students as their “first” foreign language, and because of that English teachers typically provide many hours of instruction within one school. As a consequence, they very rarely switch to teaching other subjects (6%). However, the experience of teachers in less common languages is different. As much as 13% of French teachers and 8.5% of German teachers became mainly teachers of English within the analyzed 5-year period.

The transition matrix in figure 2 also reveals significant "transfers" of teachers from different subjects to mathematics. This may be the result of existing shortages of mathematicians in schooling (Herbst and Orchowska 2023). In the absence of new candidates entering the profession, the vacant posts are filled by teachers specialized in other fields, who complete post-graduate courses allowing them to teach mathematics in addition to (or instead of) their primary subject. According to our data, 20% of informatics teachers, 14% of physicians, 8.5% of chemistry teachers, and 6.8% of geographers turned into teachers of mathematics between 2013 and 2018.

5. Discussion and conclusions

This study aims to compare the working conditions and career paths of teachers of various subjects employed in Polish schools. The motivation for the research was the fact that most regulations are uniform for all teaching specializations. In the case of Poland, but also many other countries, statutory teaching time is equal for teachers at a given schooling tier (e.g. grades 4-8). Similarly, minimum wage depends on the teacher's professional degree, and work experience, but not on the subject taught. Although uniform regulations may be justified by the common sense of justice and equality, they nonetheless ignore the fact that the field of study, and the subjects taught by teachers are strongly affecting both their everyday working experience and opportunities they face outside schooling.

Our intention was to provide an analytical basis for possible modifications in the regulations on teaching.

Wages offered to teachers are considered as a key factor in the mechanism of self-selection to the teaching profession. Even at the very early stage after graduation from the university we observe significant discrepancies in opportunity wages of potential teachers graduating in different study fields. While a teacher's starting salary may be considered attractive by young historians or graduates in Polish studies, it is very low by the standards of mathematicians, IT specialists, and physicians. With time, the differences between opportunity wages by field of studies grow, and worse, so does the gap between teacher wage and the wages outside the education sector in general. In the fourth year after graduation the expected earnings of a non-teacher exceed the typical teacher wage at this stage of the career for all fields of studies corresponding to major school subjects.

Differences in opportunity wages may be one factor behind the selective shortages of teachers: we observe much lower percent of educators holding a degree corresponding to the subject taught among teachers of mathematics, physics or informatics, than it is in the case of Polish language or history teachers.

Another important difference between teachers of particular subjects refers to their organization of work. School curriculum implies uneven intensity of instruction in different fields. Students of early grades spend almost all their class time on so-called early education provided by a single teacher. In later grades, the emphasis is put on learning Polish, mathematics, English, and on getting physical training, which is reflected by the large share of respective subjects in a student's weekly timetable. As a result, teachers of these 'core' subjects typically work in one school, and they rarely develop alternative specialization in addition to their main one. At the other extreme are teachers of such subjects as biology, chemistry,

physics, and less common foreign languages - who are forced to either teach multiple subjects, or to work in more than one school

Our analysis lets us distinguish four categories of subjects taught in Polish schools. In some cases the categories overlap, which means that teachers of some subjects are likely to belong to more than one category (see figure 3).

FIGURE 3: HERE

First, there are fields in which it is particularly difficult to attract adequately educated individuals to work in the education sector, as they usually face high opportunity wages elsewhere. This certainly applies to mathematicians, informaticians, and physicians, thus graduates of university fields typically referred to as STEM. Large wage gap between teachers and non-teachers with a STEM-related educational background is a common problem across educational systems, causing the shortage of candidates for teachers in many countries (Goldhaber et al., 2015; Fullard and Zuccollo, 2021). In Poland however, this mechanism may similarly apply to teachers of foreign languages (e.g. German and French), who are highly valued on the labour market outside the schooling system.

Second, some subjects clearly offer teachers stability at work, allowing them to have a real impact on students' formation due to the prominent position in school curriculum. These characteristics apply to early education teachers, who monopolize contact with students in the initial three grades of education, as well as to mathematicians, teachers of Polish, English, and physical education as these subjects account for a lion's share of the school curriculum in later grades.

Third, there are teachers who, because of the subject taught, are forced to either circulate between different schools, or to teach multiple subjects to meet the teaching load requirements. The most affected subjects are chemistry, physics and German, but the problem also concerns geographers, biologists and religion teachers. This can be particularly discouraging in less urbanized areas, where parallel work at several schools requires extensive commuting.

Finally, teachers of certain subjects tend to quit the teaching profession earlier than average. Intuitively, this may occur due to brain-drain in favor of sectors offering better pay. However, according to our research, "early quitters" do not necessarily respond solely to wage incentives. Pecuniary motivation might explain the observed high turnover of teachers of foreign languages, but, on the other hand, the relatively low drop-out of STEM teachers does not fit such an explanation path. Moreover, the observed high drop-out among the early education teachers is unlikely to be caused by attractive opportunity wages for graduates of pedagogical studies. One possible explanation for the latter phenomenon is that working with students in early childhood education is particularly demanding and therefore more likely to cause professional burnout, leading to resignation. However, while some previous studies support such an argument (Goddart et al., 2006; Antoniou et al. 2013), most studies do not consider either the stage of education or the age of students as a strong differentiating factor in teachers' vulnerability to professional burnout.

Individual decisions on whether to become a school teacher or not, as well as teachers' choices on whether to stay in the profession or leave, pursue the initial specialization or change it, are determined by many factors related to both working conditions and individual life experience. However, our research shows that subject-specific regulation of teacher employment might

help to attract teachers to schools and to reduce their attrition. The evidence suggests that teachers of mathematics need to be paid more if we want to account for high opportunity wages they face outside the education sector. At the same time, they can teach a lot of hours in one school, as mathematics takes up a prominent part of the school curriculum.

Given the wage - satisfaction relationship evidenced by TALIS (cf. Schleicher 2020), attracting large number of new STEM teachers to schools is impossible without raising their pay. On the other hand, demanding that they wages level up with the opportunity salaries outside education sector seems unrealistic. Therefore, Poland, similarly to other countries suffering from shortage of STEM teachers, will have to expand alternative pathways to recruit teachers, potentially impacting teaching quality and not addressing retention (European Commission/EACEA/Eurydice 2021).

Keeping the required teaching time for teachers of biology, chemistry, and less popular foreign languages at the same level as that of mathematicians makes teachers work simultaneously in many schools, which negatively affects the teaching process and relationships between students and teachers. One may thus imagine an arrangement in which teachers of mathematics have a higher teaching load, but they also earn more compared to teachers of some other subjects. Since a teacher's ability to meet the statutory requirement for teaching hours depends on the subject being taught and the needs of the local school system, it seems prudent to make the regulations on teaching time more flexible. For example, instead of an exact number of hours, a permissible range could be set within which the head of the school would be free to assign each teacher an appropriate amount of teaching time.

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Figure 1. Opportunity wages of teachers – one year versus four years after graduation

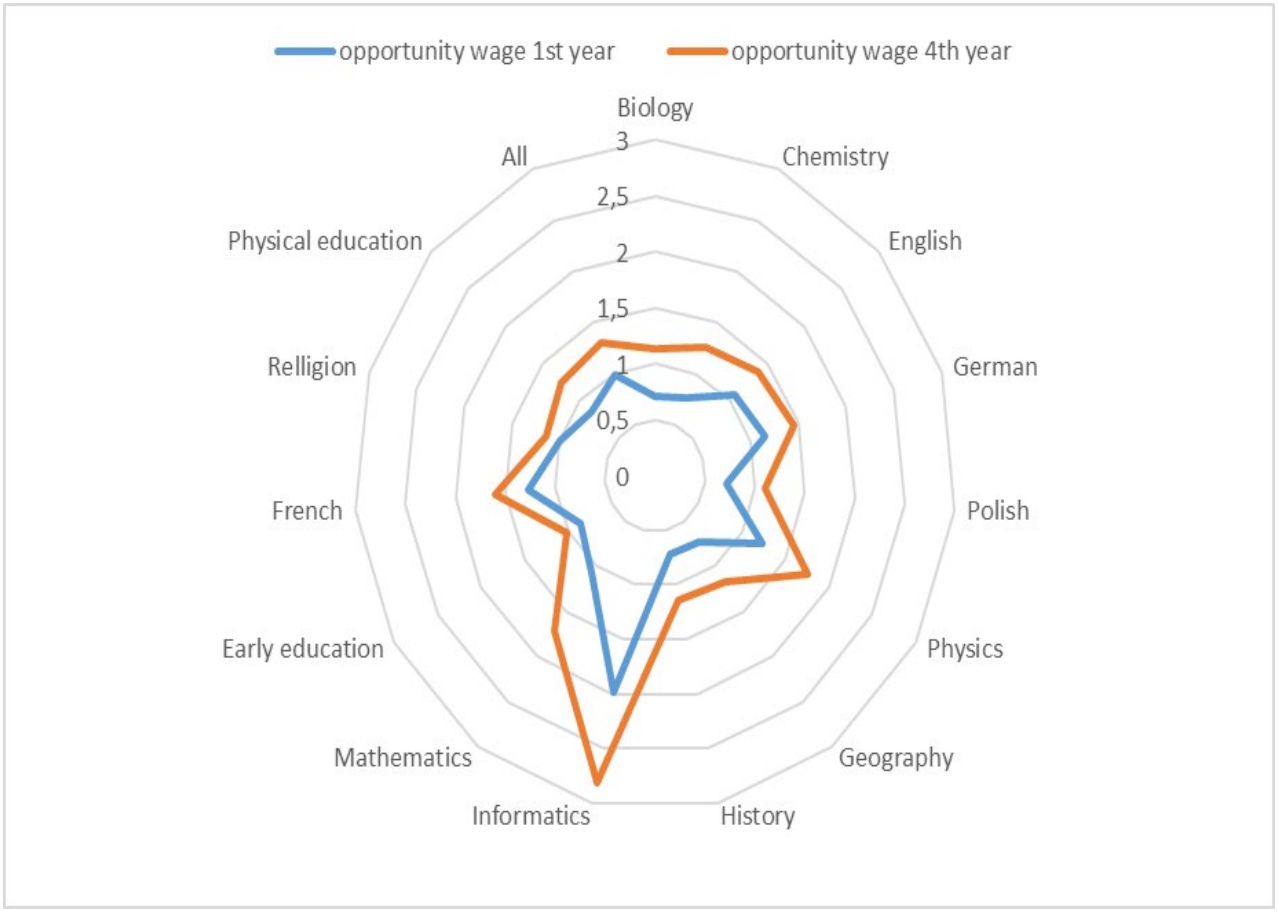

Figure 2. Transition matrix - main subject of novice teachers in 2013, and then of the same teachers in 2018

2013 \ 2018	Biology	Chemistry	Geography	History	Informatics	English	French	German	Polish	Mathematics	Ph. education	Physics	Early education	Religion
Biology	70	17	6.8	1.1	1.1	1.1	0	0	0	1.1	0	1.1	0	0
Chemistry	12	68	2.4	0	0	0	0	0	0	8.5	0	8.5	0	0
Geography	0	0	89	1.4	0	0	0	0	0	6.8	0	1.4	1.4	0
History	0	0	1.3	87	1.9	0	0	0	5.1	0	0	0	4.4	0.6
Informatics	0	0	0	0	73	0	0	0	0	20	1.9	3.9	1	0
English	0.5	0.1	0.5	0.4	0.1	94	0	0.9	0.7	0.5	0.4	0	1.8	0.1
French	0	0	3.2	0	0	13	77	3.2	3.2	0	0	0	0	0
German	0	0	0	0.5	0	8.5	0	84	1.6	1.6	0	0.5	3.2	0.5
Polish	0	0	0	2.6	0.3	1.3	0	0	93	0.3	0.3	0	2.1	0
Mathematics	0	0.6	0	0	2.6	0	0	0	0	92	0.6	2.9	0.6	0.3
Ph. education	0.5	0	0	0.3	0.7	0	0	0	0	0.2	97	0.3	1	0
Physics	0	5.4	0	0	8.1	2.7	0	0	0	14	0	70	0	0
Early education	0.8	0	1.1	0.3	1.9	5.8	0	0.5	3.4	1.6	3.2	0.3	81	0
Religion	0	0	0	0.4	0.3	0.4	0	0	0	0.4	0.3	0.1	0.7	97

Figure 3. Typology of subject teachers

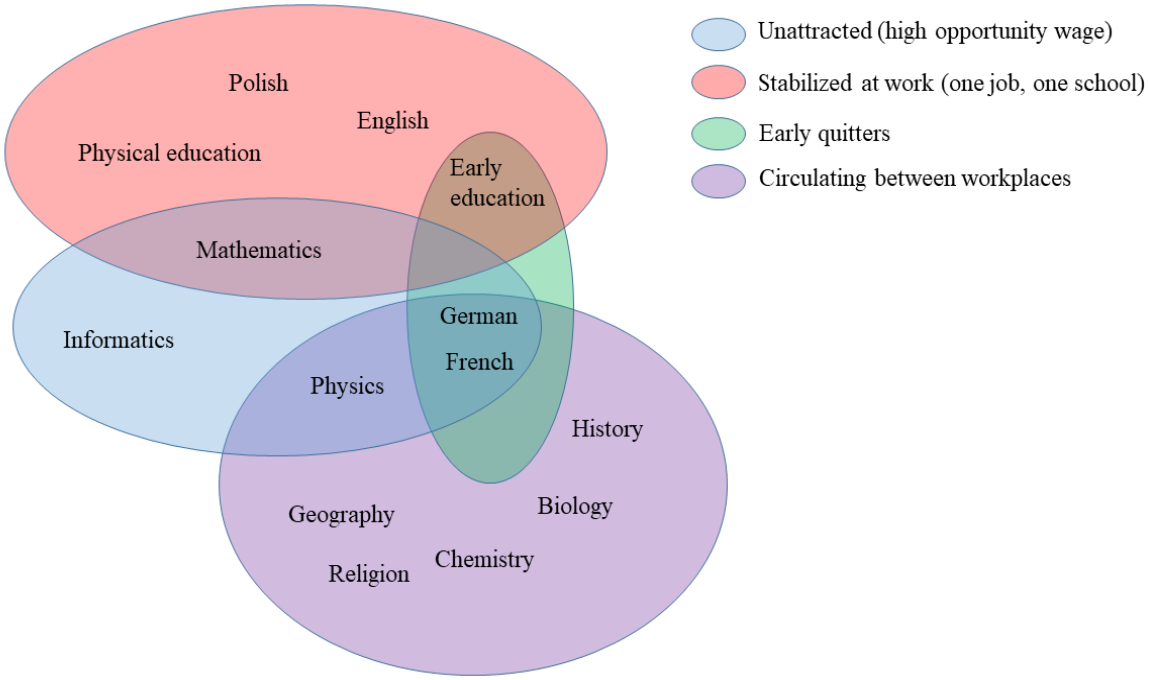

Table 1 - List of indicators

Indicator	Data source (year)
Group 1 - Attractiveness of teaching while entering the labor market	
Opportunity wage within one year from graduation, as percent of a starting wage for teachers	ELA, Min. of Education (2015)
Percent of peer graduates working as teachers within one year from graduation	ELA (2015)
Percent of novice teachers in the workforce (FTE)	SIO (2015)
Average age of a teacher	SIO (2017)
Percent of teachers holding university degree in respective subject	Survey of Warsaw teachers (2022)
Group 2 - Workload at different stages of the career	
Average number of schools in which a teacher works (within subject) - in the 1st, 3rd, and 6th year of employment	SIO (2013-2018)
Average workload (within school and subject) as percent of full time - in the 1st, 3rd, and 6th year of employment	SIO (2013-2018)
Weekly hours of instruction as required by the curriculum (average for grades 4-8)	Min. of Education (2019)
Group 3 -Attractiveness of teaching - perspective of an established teacher	
Opportunity wage in the fourth year from graduation, as percent of a corresponding wage for teachers	ELA, Min.of Education (2015-2019)
Percent of peer graduates working as teachers in the fourth year from graduation	ELA (2015-2019)
Dropout of teachers after three years	SIO (2015-2018)
Percent of teachers with 7-year experience promoted to nominated degree	SIO (2011-2018)
Percent of teachers who changed their specializations (5 years after starting their work)	SIO (2013-2018)

Table 2. Attractiveness of the teaching career at the early stage after graduation - indicators

	(1)	(2)	(3)	(4)	(5)
	Opportunity wage within one year from graduation, as percent of a starting wage for teachers	Percent of peer graduates working as teachers within one year from graduation	Percent of novice teachers in the workforce (FTE)	Average age of a teacher	Percent of teachers holding university degree in respective subject
Biology	71.5%	4.3%	1.6%	46.8	68.0%
Chemistry	76.7%	1.5%	1.7%	45.8	74.2%
English	107.3%	16.8%	4.4%	39.4	78.6%
German	115.0%	12.8%	1.7%	41.9	95.0%
Polish	71.7%	16.0%	1.4%	45.8	81.4%
Physics	122.8%	1.8%	0.8%	46.8	60.4%
Geography	74.4%	4.9%	1.3%	46.6	54.8%
History	72.7%	6.1%	1.5%	46.4	71.6%
Informatics	198.8%	0.3%	1.3%	46.5	34.5%
Mathematics	107.0%	10.8%	1.6%	46.0	68.4%
Early education	85.5%	26.5%	3.9%	47.4	77.1%
French	126.9%	7.3%	2.6%	45.8	89.0%
Religion	100.1%	35.4%	3.5%	44.2	NA
Physical education	85.3%	18.6%	2.2%	44.1	89.0%
All above	98.0%	18.4%	2.7%	44.8	74.60%

Table 3. Workload and number of workplaces of teachers by subject

	Average number of schools in which a teacher works (within subject)			Average workload (within school and subject) as percent of full time			Weekly teaching hours required
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Subject	year 1	year 3	year 6	year 1	year 3	year 6	grades 4-8
Biology	1.31	1.35	1.65	0.44	0.48	0.45	1
Chemistry	1.34	1.36	2.16	0.45	0.51	0.56	0.8
English	1.30	1.37	1.33	0.81	0.91	0.92	3
German	1.29	1.52	1.95	0.68	0.78	0.76	0.8
Polish	1.22	1.27	1.28	0.71	0.75	0.87	5
Physics	1.29	1.41	1.95	0.49	0.55	0.51	0.8
Geography	1.50	1.56	1.84	0.49	0.58	0.50	1
History	1.37	1.34	1.46	0.43	0.42	0.55	1.8
Informatics	1.23	1.23	1.29	0.30	0.35	0.41	1
Mathematics	1.30	1.34	1.33	0.69	0.77	0.90	4
Early education	1.00	1.00	1.00	0.83	0.86	0.84	12*
French	1.29	1.52	1.52	0.58	0.68	0.59	0.8
Religion	1.41	1.52	1.67	0.64	0.73	0.78	
Physical education	1.21	1.26	1.32	0.60	0.61	0.76	4
All	1.28	1.35	1.48	0.72	0.82	0.89	24**

*grades (1-3); **grades (4-8)

Table 4. The attractiveness of working in a school - the perspective of an established teacher.

	(1)	(2)	(3)	(4)
	Opportunity wage in the fourth year from graduation, as percent of a corresponding wage for teachers	Percent of peer graduates working as teachers in the fourth year from graduation	Dropout of teachers after three years	Percent of teachers with 7-year experience promoted to "nominated" degree
Biology	113.3%	8.7%	23.1%	55.4%
Chemistry	124.8%	5.1%	21.8%	43.6%
English	138.3%	19.6%	22.9%	50.1%
German	144.8%	17.1%	30.1%	51.2%
Polish	109.5%	25.3%	20.8%	44.3%
Physics	175.4%	2.0%	21.5%	43.3%
Geography	118.1%	9.2%	23.3%	56.8%
History	113.8%	13.0%	23.3%	57.4%
Informatics	280.9%	0.4%	18.8%	66.4%
Mathematics	171.7%	15.7%	15.9%	50.0%
Early education	101.4%	32.8%	24.2%	52.8%
French	160.4%	7.3%	33.3%	55.0%
Religion	114.4%	44.7%	22.7%	55.5%
Physical education	125.1%	29.0%	19.3%	65.4%
All above	130.6%	24.1%	22.4%	53.1%

Table 5. Preserving versus changing teaching specialization between 2013 and 2018

	(1)	(2)
	Percent of novice teachers still teaching same main subject after five years	Percent of novice teachers who switched their main subject after five years
Biology	73.6%	26.4%
Chemistry	68.7%	31.3%
English	94.4%	5.6%
German	83.6%	16.4%
Polish	93.8%	6.2%
Physics	68.4%	31.6%
Geography	87.7%	12.3%
History	86.2%	13.8%
Informatics	73.5%	26.5%
Mathematics	92.3%	7.7%
Early education	81.0%	19.0%
French	77.4%	22.6%
Religion	97.4%	2.6%
Physical education	97.0%	3.0%
All	90.7%	9.3%